Expressive Interactions: Tablet Usability for Young Mobile Learners

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ABSTRACT
In this paper we examine the usability of tablet devices for students in middle school in the context of mobile environmental education. Our study focuses on the expressive qualities of three input methods – text, audio and drawing – and the extent to which these methods support on-task behaviour. In our study 28 small groups of children were given iPads and asked to record ecological observations from a round their schoolyard. The effectiveness of the devices and their core utility for expressive, on-task data capture is assessed.

Author Keywords
Mobile learning, design, educational technology.

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): User interfaces.

INTRODUCTION
With tablet computers becoming increasingly ubiquitous, it is worth assessing what role they can play in school-based education. Investigation of their potential value and usability and their expressiveness is relevant across a range of contexts. In this paper, we assess three interaction modes – touch-screen typing, drawing and audio recording – in the context of simplified scientific data collection. Our research aims to understand each interaction in terms of:

- Usability as effectiveness in enabling children to achieve goals, and learnability created by ease of use;
- Capacity to support on-task behaviour as defined by the extent to which records created by children related to the task at hand; and
- Expressiveness, shown by depth of communication.

Our findings indicate that children find audio the most effective and easy to use mode. We also found that while typing provided the most reliable and ‘on-task’ data capture, both audio and drawing provided more expressive interaction.

BACKGROUND
Education for environmental sustainability (EES) is an area of the curriculum that is well suited for incorporating new and interactive mobile technologies. In particular, those that can be used in groups and have the capacity to encapsulate multiple key learning areas such as data capture and manipulation (Smith et al., 2005), scientific classification techniques (Chen et al., 2003) and the use of multimedia resources to clay contexts and processes (Gay et al., 2002). In examining the relationship between children and mobile technology we focus on the importance of context in the mobile learning experience. The outdoor data collection dictated by our study area of EES provides a rich context to examine mobile device use situated within a school context. The study focuses on the interactions offered by mobility within a physical space (Sharples et al., 2007) as children move through the school playground to record ecological observations.

The use of mobile devices within a learning context creates a complex relationship between children, activities, the environment and the technology (Wyeth and MacColl, 2010). Personal tools and cultural artefacts are important educational resources; they allow children to make ideas tangible, to share them, to negotiate meaning, and to communicate (Ackerman, 1996). In this context, we look to assess the effectiveness of tablet devices for expressive interaction, as children capture data through text, audio and drawing. We look at how the quality of being “ready-to-hand” (Dourish, 2001) allows children to work through the tablet interface to perform data collection activities. Our interest lies in how children can make ideas tangible, to share them, to communicate (Ackerman, 1996). In this context, we look to assess the effectiveness of tablet devices for expressive interaction, as children capture data through text, audio and drawing. We look at how the quality of being “ready-to-hand” (Dourish, 2001) allows children to work through the tablet interface to perform data collection activities. Our interest lies in how children can make ideas tangible, to share them, to communicate (Ackerman, 1996).

STUDY APPROACH
We conducted our study on ‘science day’ at a suburban state primary school. The study participants were four classes of students aged 11 to 13, and of mixed gender. Students were divided into groups of two and four (most commonly three) and given an iPad with which to conduct the ecological observation and data collection activity. Twenty-eight groups participated in the study and each was given an iPad with the following apps on the main (iOS 3.2.1) home page:

- iBooks (Apple Inc.): a PDF viewer pre-loaded with a five-page reference guide;
were used to evaluate expressiveness.

creative input and examining the extent of personalisation was rated on the 'on-task' scale outlined in Table 1.

Assessing the level of detail, looking for examples of canvasses) were not included in the analysis. Each record was comprised of 10 to 15 minutes introduction, 20-25 minutes exploring the school and a 10-minute wrap-up.

Study Instruments and Analysis Methods

Study data was captured through analysis of the records created on the i Pads during the sessions. This data included audio recordings, w ritten notes and drawings. The record was categorized as an individual observation. Some groups created one file per observation, while others recorded multiple observations n on e file (e.g., multiple observations n on s advertisements within a N ot e s file). R ecords that were “blank” (e.g. silent audio recordings of less than 2 seconds and blank drawing canvases) were not included in the analysis. Each record was rated on the ‘on-task’ scale outlined in Table 1. Assessing the level of detail, looking for examples of creative input and examining the extent of personalisation were used to evaluate expressiveness.

<table>
<thead>
<tr>
<th>On-task</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully</td>
<td>Rich descriptive detail</td>
<td>Very tiny dark green spider and a black spider with yellow spots.</td>
</tr>
<tr>
<td>Mostly</td>
<td>Some detail</td>
<td>Black and yellow ladybird.</td>
</tr>
<tr>
<td>Partly</td>
<td>Brief description</td>
<td>We saw a butterfly.</td>
</tr>
<tr>
<td>Most off</td>
<td>Loosely related</td>
<td>We met lots of people.</td>
</tr>
<tr>
<td>Off-task</td>
<td>No meaningful data</td>
<td>Tech guy has cool sunglasses.</td>
</tr>
</tbody>
</table>

Table 1: The ‘on-task’ rating scale used to classify records.

In the wrap-up, students filled out a brief questionnaire designed to assess the usability of iPads generally, and of typing, drawing, and audio recording more specifically. 

Observational data indicated that the students embraced iPad use, taking responsibility for overcoming usability issues they encountered, including plants, trees, birds, insects, spiders, reptiles, mammals. I nt his introductory session, students were given a brief tutorial on how to use each iPad application. Each session was comprised of 10 to 15 minutes exploration of the school and a 10-minute wrap-up.

Usability

Observational data indicated that the students embraced iPad use, taking responsibility for overcoming usability issues they encountered. Only two students groups used only two methods. Students were seen taking their iPad to facilitators for assistance, one for help creating a new audio memo and the other due to GPS failure in Maps.

Survey results indicated that the function students rated as having the greatest ease of use was recording audio, with only one negative response and almost 90% agreeing that audio was ‘easy’. Ease of use of a digital input is supported by the large numbers (147) of valid audio records produced by children. The longest recording was almost 8 minutes and an e xample of a single entry on a page was produced multiple times. Several groups took this approach rather than creating a new entry for each observation.

Typing text received double the number of negative and ‘not sure’ responses, with about 80% agreeing it was ‘easy’. Captured records also support the survey data with respect to typed input. Notes represented the smallest pool of captured records with 7 to 15 text records created using the digital keyboard. Many of the notes were very brief; 78% of typed records were less than 10 words.

Drawing had the poorest usability rating with just over half of valid responses agreeing that it was ‘easy to use’, and the greatest negative a nd un sure responses o f a ny category at almost 10 and 30 percent respectively. Data captured supports this finding as drawing had the highest percentage of blank audio records. W hile t he were 78% valid drawing records generated, there were also 32 s ave d drawing files containing no data. Drawing activities involved participants verifying and verifying information on the school map (19 records), constructing a habitat profile using a template (5 records) or producing a drawing on a blank page (54 records). The variation in record numbers indicates children preferred working without the overlays.

Task Oriented Behaviour

Notes had the highest ‘on-task’ rating with 84% of records at least partly on-task (see Figure 1). Two off-task records represented mistakes likely due to interface or other distractions. Only one text record was identified as completely off-task. An additional nine records were categorized as mostly off-task.

In the wrap-up, students filled out a brief questionnaire designed to assess the usability of iPads generally, and of typing, drawing, and audio recording more specifically. Students were given a brief tutorial on how to use each iPad application. Each session was comprised of 10 to 15 minutes introduction, 20-25 minutes exploring the school and a 10-minute wrap-up.

In total, 78 out of 147 drawings were produced. Seventeen groups used all three input methods, nine used two methods and one used only one method. There were significant variations in the number of observations produced, with one group on 26, another on 15, and one group produced 20. Twenty-four of the blank page drawings were attempts to capture some element of the environment in a drawing. All but four of these drawings were considered to be at least partly on-task, but only one produced a drawing. Of the 19 map files containing data, 11 were categorized as at least partly on-task. Only two students produced only on-task drawings and six produced only off-task.

A majority of drawings were completed on blank pages (20 of the 29 off-task records). Thirty-four of the blank page drawings were attempts to capture some element of the environment in a drawing. All but four of these drawings were considered to be at least partly on-task, but only two produced only on-task drawings and six produced only off-task. A majority of these drawings were completed on blank pages (20 of the 29 off-task records). Thirty-four of the blank page drawings were attempts to capture some element of the environment in a drawing. All but four of these drawings were considered to be at least partly on-task, but only two produced only on-task drawings and six produced only off-task.

A majority of ‘off-task’ drawings were completed on blank pages (20 of the 29 off-task records). Thirty-four of the blank page drawings were attempts to capture some element of the environment in a drawing. All but four of these drawings were considered to be at least partly on-task, but only two produced only on-task drawings and six produced only off-task. A majority of these drawings were completed on blank pages (20 of the 29 off-task records).
Sixty-nine percent of audio records were categorized as partly on-task or be tter. Audio records rated ‘fully on-task’ varied in length from 17 s econds to just over a minute, indicating the time a record to be most effective falls in this window (brief, well structured and to the point). There were 25 audio records rated as off-task; four represented problems with the interface or device (e.g. “should I press record?” and “woh, it’s pretty heavy!”). Twenty-one others (approximately 14%) could be regarded as intentionally off-task.

Figure 1: Level of on-task across text, audio and drawing.

Expressive Interaction

We analysed the records created during data collection to establish whether the audio and drawing records facilitated expressive interactions. Table 2 provides a n e xample of on-task data produced through each medium. A majority of the notes contained a brief description of flora or fauna that had been observed in the p lacement. N otes were generally succinct and to the point. Even those records that were categorized as mostly off-task were short pieces of information. These records generally described the people that were encountered, a location (e.g. “oasis”, “outside toilet next to shed”) or were a comment on the process (e.g. “having great difficulty finding any animal”). There were only three examples of personalization or interesting self-expression within notes:

- We found a FEATHER!!!!! Luv George
- Butterfly it was beautiful with yellow and black wings It was flying near the yellow flowers (agapanthus) it was fluttering round in circle we almost caught it! Hehe lol.
- Ant Small, black, 6 legs, looking for food, three section of body wow really huh?!

Audio records c learly of fered opportunities for c reative and e xplorative interactions. Sixty-two percent of audio records contained more than one sentence with the average recording lasting 35 s econds. When on-task, these records included rich descriptions (see Table 2), personal r eflections (e.g. “We heard some Myna birds singing near the basketball court. They sounded very lovely”) and a d e voicing. Personal r eflections (e.g. “We have just discovered a lorikeet, rainbow lorikeet”. (girl) “Three!” (boy) “Three lorikeets?” (g irl) “Yeah!” (b oy) “Very interesting. And it is up in the tree in front of us right now”). Collaborative e xpression was u s ual ly common, with students finishing each other’s sentences or helping if the main speaker was lost or words. I n ot her g roups, however, iPad ownership was taken quite seriously a nd the ‘reporter’ would repeat or r ephrase a l l o bservations made by group members in the field. A few groups also conducted an interview style of questioning to encourage the flow of observations. O ne of the most interesting aspects of t he records was the narrative play adopted by five groups, with students of both sexes putting on a voice t o make t heir o bservations. O ut o f t he ten ‘dramatic’ records, six related to the task in s ome way, indicating narrative play motivated some groups to engage with the activity.

Table 2: ‘On-task’ example with text, audio and drawing.

<table>
<thead>
<tr>
<th>Text Record</th>
<th>Audio Recording</th>
<th>Drawing Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a small black spider near the grade fours and it has small dot on it. It is moving around its web. (girl1) We saw a spider web, a very small one and a really tiny spider on it (girl2) it's a very circular web, it's a very small spider, it's almost invisible – very good hiding spot for the spider</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Drawings created by study participants.

While many of the audio records produced were focused and on-task, t he e xpressiveness of t he medium al so resulted i n b ehavior that might b e seen a s undesirable within a n e ducational context. For example t he t hese records t hat in cluded s wearing and n ame c alling, t hat discussed g enitalia (e.g. (boy1) “they’re really fat and ugly” (boy2) “oh, look at the size of those penises”) and that demonstrated silly b ehavior (e.g. “putting on no voice and g asp, gasp” “I am Darth Vader, come to the dark side!”). W ith over 30% of audio records categorized as off-task t o s ome e xtent, t here were m any e xamples of off-topic utterances. Even w ithin ‘on-task’ recordings t here were many examples of off-topic utterances.

CONCLUSION

Our study focused on children working through a tablet interface to perform data collection activities. Table 3...
provides a summary of our findings. Of particular interest was the extent to which children used a screen interface, which was ‘least seamless’, allowing more freedom to observe and record extended interaction. The ease with which children could interact with findings was a significant feature of the study. Participants could start a recording and then immerse themselves within the task of being an eco-detector. Of the other two input methods, participants found drawing the most difficult. In considering the degree to which typing, audio and drawing input could be said to be “ready-to-hand”, while the current generation of tablets have improved usability dramatically through heightened direct manipulation, extreme portability and larger, more immersive screens, it is easier to talk about what we see than it is to work with a screen to record our observations.

<table>
<thead>
<tr>
<th>Usability</th>
<th>‘On-task’</th>
<th>Expressiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typing</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Audio</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Drawing</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

Table 3: Assessment of tablet-based input methods.

Assessment of ‘on-task’ behavior shows that typing produces the best results. In part, this result may be seen as a reflection of its interface — since typing out in-the-field may be more cumbersome, fewer entries are created yet they are also more focused. While many audio entries contained rich detail and were on-task, there were also a significant number of irrelevant and off-lensives. Raw data reformed poorly within this category and many of the drawings produced were not directly linked to data capture tasks. It was clear that participants spent time experimenting a s they scribbled, wrote their names and created shapes and lines.

While participants in dictated th at d rawing was more difficult than typing, the number of drawings and notes produced were roughly equivalent. Analysis of drawings demonstrates that participants found s t o b e a more expressive and creative medium than typing. Given the age group, this result may not be surprising: while children of this age are generally fluent writers, they are in the early stages of becoming self-assured and creative. The data on this interaction was less than typing. Given the co-laborative engagement supported a n d the role-play opportunities provided, it contributed to the interaction’s quality. Exploration facilitated through a modality that is ready-to-hand supports the expressive personalization observed in audio recordings. Seamless immersion is enabled through simple controls that are not, at present, replicated by the screen-based interface.

One area that we have not explored in this study is the degree to which the novelty of the technology itself was an issue. While our participants are, almost by definition, ‘digital natives’, tablets are not commonplace. We plan on re-evaluating the model with similarly aged children who have an iPad to explore appropriation with longer-term use.

In conclusion, typing is clearly the best means to ensure data capture that is on-task and reliable. Drawing offers the capacity for unique interpretations of the data and does not require a recording of a reference and context. This personalization can help facilitate a sense of device ownership, but the raw data remains a challenging mobile interaction mode with questionable usability and reliability. With the level of engagement generated by audio recording, it seems to offer the greatest potential as an in-the-field notation tool. With further refinements to entry structure, audio could prove to be a valuable data capture medium, allowing more freedom to observe and interact with findings.

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REFERENCES

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